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Ann Arbor Workshop on AGS Polarization

AGS CNI Polarimeter

Goal: use proton-carbon CNI elastic scattering, as for the RHIC polarimeters, measure asymmetry from AGS injection energy to RHIC injection energy. If possible, measure on AGS ramp.

---CNI polarimetry, when the recoil carbon is measured using time of flight and energy, clearly identifies the elastic reaction

---the microribbon target survives the high beam intensity we use

---with a wide target width, the measurement can be made in a short time (seconds to minutes)

---it might be possible to measure the asymmetry on the ramp, so that it won't be necessary to set up a flattop at the desired energy

The present polarimeter: uses proton-proton elastic scattering at medium t ($t=0.15\ GeV^2/c^2$)

---with the high polarized source intensity, a hydrocarbon target cannot survive. Therefore a carbon target is used, and quasi-elastic scattering is measured instead of pp elastic. The analyzing power is about half, and the recoil proton is not clearly identified.

---at 24 GeV, the measurement takes about 20 minutes, with a flattop and debunching required

The idea is to provide a better tool to investigate depolarization and corrections in the AGS.

Experience: E950, where we first tested and calibrated the RHIC CNI polarimetry, .

Issues:

1. beam size at injection into AGS ==> longer target than RHIC (Bill Lozowski of Indiana is working on this, along with a wider target.)

2. long bunches in AGS, time of flight resolution ==> place detectors at 25 cm radius vs. 15 cm for RHIC (time is then roughly 120 ns for 200 keV carbon)

3. noise environment in AGS ==> E950 worked, but this is a major issue requiring work

4. analyzing power vs. energy ==> cross calibrate with AGS pp polarimeter, can also consider calibrating at injection energy at COSY. Calibrated at 22 GeV by E950. Absolute calibration not as important—issue is to spot depolarizing resonances in ramp

5. sufficient rate ==> factor 100 wider target than for RHIC, use 6 bunches with 2 x 10^{11}/bunch, 2 RHIC type silicon detectors, get 1M events in 300 ms at injection energy**

6. ramp measurement requires 50 measurements over 600 ms ramp ==> 10 ms time window, or 30 ramps to collect 1M events at lowest energy

7. coding wave form digitizer for 50 measurements ==> new WFD has capability (decision to use new version WFDs, which were used for half the channels for the RHIC polarimeter this year, for AGS. RHIC will also use all new version WFDs next year)

8. too much rate ==> present calculation gives about 20% double hits in strip. We need to decide what is acceptable, and select the target width

Plans and schedule: we are designing the chamber, ordering valves and parts for the target mechanism, etc. Plan is to have the AGS CNI polarimeter in place for the 2003 run.

Do we need help? You bet. We have a small group from CAD, UCLA and RBRC working on this now, and certainly can use help!

Status of AGS CNI Polarimeter, Nov. 2002

1. Team: Jeff Wood (Ph.D. student, UCLA), Sandro Bravar, Haixin Huang, Osamu Jinnouchi, Igor Alexeev, Dima Svirida, Satish Dhawan, Bill McGahern, George Mahler, CA-D, UCLA shop, George Igo, Vernon Hughes, Gerry Bunce

2. Target: Bill Lozowski succeeded in developing method for longer target (2 inches), to allow us to put target in at the AGS injection energy; Bill also succeeded in making much wider targets (1/2 mm), but still very thin. We have also developed a target facility at CA-D to make these ultra thin targets.

3. Wave form digitizer: we use the "new-type" WFD, which has sufficient memory for the measurement on the ramp. Additional WFDs are being built by Satish Dhawan, but this type of WFD was already used for the RHIC polarimeters. Igor Alekseev and Dima Svirida have written the FPGA code for the WFDs for the ramp measurement. They arrive at BNL this month to install and test the code (provided Igor gets a visa...).

4. Considerable work was done to study the pickup from the passing beam in the silicon (this is observed in RHIC), and also to study and reduce noise. A shield box has been introduced around the preamp cards. The polarimeter is installed in the AGS, with 2 silicon detectors at 90^0, left and right, and 4 long vertical targets ½ mm wide. The alphas from the ^{241}Am source are seen in the detectors. We will test the polarimeter with deuterons in the AGS in December, and expect to be ready for a January 2003 polarized proton run in the AGS.

5. **Rate:** expect about 10^6 events/s. We use 2 x 10^{11} protons x 6 bunches, ½ mm wide target, beam sigma 0.8 mm (24 GeV).

6. **Required number of events:** use $A_N(pC) = 0.015$, $\Delta P = .06$ for 10^6 events.

7. **Flattop measurement:** 1 second flattop, 1 AGS cycle required.

8. **Ramp measurement:** 2 ms binning, 10^6 events per bin, need 500 AGS cycles

9. **Pileup:** 10^6/s /6 silicon strips x 50 ns = 8 x 10^{-3} probability (ok??) (the peak in the silicon is set on the low t side by the thickness of the deadlayer, and on the high t side by the falloff of the cross section. It is typically 3 strips wide)

Some Issues to Resolve

---recoil angle changes vs. energy for fixed t—the detectors have been installed with strips along beam to measure scattering angle. Will we sum over all strips or match t range vs. energy? A major concern is that each detector has different dead layer thickness. The deadlayer thickness determines the acceptance cutoff at low t. If this cutoff is set by the detectors and not by software, there may be a large left-right apparatus asymmetry.

---calibration of A_N^{pC} vs. energy, using E880 polarimeter---the E880 polarimeter requires debunched beam on flattop, vs. loading the AGS with 6 bunches of alternating polarization sign, and using bunched beam for the CNI polarimeter. Also, E880 uses pp elastics and requires a hydrocarbon target. We will need to choose a low beam intensity so that the hydrocarbon target survives.

---rate dependence (pileup)---if we have too much rate, we may need to use narrower target (also develop a pileup monitor)

---measurement on the ramp will take time to develop---we should plan to start with flattop measurements